The First Decade of Computer Science in Argentina

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Abstract. Computer science has a curious history in Argentina: it began late (more than ten years later than in USA), had a ten-year span of flowering, was completely destroyed by the military dictatorship in 1966 and, disregarding some advances in small universities in the 1970s, began to weakly revive in 1983. In this article we shall analyze the ten-years long (1956-1966) "golden age" of computer science in Argentina, that is imbedded into a "golden age" of Argentinean universities.

1. Introduction

For reasons that Babini [2] clearly explains, Argentina entered the computer age with a considerable delay. In fact, Argentina entered the computer age after Perón's fall, in 1955, that is, one decade after the electronic "protocomputer" ENIAC began to function [7]. This decade of delay had, unfortunately, political causes. The policy of maximum possible autarchy during almost all the years of the first Perón administration (1946-1955), plus his mistrust vis-à-vis the universities, which he considered essentially unfriendly to his government (and from where he fired as many opponents as he could), caused a considerable delay in many areas, and therefore a tremendous damage. With regard to informatics no benefit can be ascribed to Perón's policies; on the contrary, the cost due to the theoretical and commercial delay was extremely high. During Perón administration, as Babini indicates in his book, the most advanced equipment consisted of tabulators based on punched cards. There was no research in informatics, and very few people realized what was happening abroad.

2. The Historic Context 1955-1966

Only after Perón's fall, in September 1955, due to a military coup d'état, can we speak about development of informatics in Argentina. On the one hand, it was easier to import foreign equipment, so that the eventual arrival of computers to Argentina was facilitated. On the other hand, autonomy was guaranteed to the national universities, and in some of them a group of intellectuals that considered science and technology extremely important for any project of development in Argentina acquired a strong influence; in particular, this group was particularly significant at the University of Buenos Aires, the most important one. The political climate during almost all the period 1955-1966 was very curious: a grave and not solved political crisis originated in the proscription of the Peronist Party. Consequently, a lack of legitimacy of the constitutional authorities (Presidents Arturo Frondizi, 1958-1962, and Arturo Illia, 1963-1966; President José María Guido administration, 1962-1963, was in fact a military government, that did not changed anything, in which Guido was a puppet). Such was the framework under which this group of intellectuals exerted their strong influence, above all in the University of Buenos Aires, and partially replaced the old guard of conservative professors. These intellectuals considered that universities had a social responsibility and had to be instrumental to the national development and to the transformation from a developing to a developed country; in a sense, their ideas were based on an almost naïve belief in the power of science and technology, "soft" as well as "hard", as a tool for development. They created university degrees in political economy, sociology and psychology (areas that the military and the conservatives suspected of "communism"); they created an university publishing house that during many years was the most important in Latin America. In addition, they supported all kind of science and technology and, of course, they were interested in computer science and the fascinating perspectives that this science seemed to offer.

Therefore, during the almost eleven years that the university was governed autonomously, a peculiar situation happened in which a large group of people in different universities, and specially in the School of Science of the University of Buenos Aires, with an unusual enthusiasm, contributed to transform the university structures. They became modern and democratic centers for teaching and research, under the constant menace of a governmental intervention, given that this project was considered communist by many powerful political actors, among them of course the Army.

The menace materialized one month after the coup d'état that, on June 28, 1966, overthrew President Illia and replaced him by a military dictator, General Juan Carlos Onganía: on July 29, 1966, the government revoked the autonomy of the universities. Some hours later, the Police entered violently into the School of Science of the University of Buenos Aires, and savagely struck students, graduates

and faculty, in a brutal incident that from then on was called "the night of the long sticks" [10]. And this was the end of the "golden decade" of the Argentinean universities (anyway, let us not forget that the transformation of the Universities was partial, at most: the Dean of the School of Law of the University of Buenos Aires was appointed Justice of the Supreme Court by General Onganía).

3. Computer Science During the Period 1955-1966

The "golden decade" 1956-1966 was witness of an impressive development in the School of Sciences of the University of Buenos Aires. The development began in 1955 with the new Dean José Babini, during whose administration the departmental organization of the School was implemented, full-time professors were appointed and scientific research was stimulated, and continued under the administration of Rolando Víctor García, Dean between 1957 and 1966. The outstanding personality and leadership of García was extremely important in overcoming the permanent budgetary and bureaucratic difficulties of state institutions (see for instance [6]). García strongly supported the decision of the University, in 1957, of constructing a new building on the new University Campus. They would move there the School of Sciences, as part of an ambitious plan to bring the Schools - or, at least, several of them - to that campus (incidentally, the plan was only partially completed: besides the School of Sciences only the School of Architecture and a Department of the School of Engineering eventually moved to the Campus). In addition, here we must mention García's Deputy Dean, Manuel Sadosky.

Among all the figures that contributed to the creation and development of computer science in Argentina Manuel Sadosky clearly stands out. When the University of Buenos Aires began its reorganization after Perón's fall in 1955, Sadosky joined the School of Sciences as a Professor at the Department of Mathematics (he was very soon elected Deputy Dean of the School), and began to think in the development of applied mathematics. In those times, most scientists considered the computer only as a device with which calculations with many numbers could be done very fast (what, of course, is true) and so as a powerful tool for helping other sciences, and particularly applied mathematics. Sadosky could easily intercommunicate with the scientists: he was an applied mathematician himself (a *rara avis* in Argentina, then and perhaps now) who had realized the eventual power of computers. He had fellowships in France and Italy at the end of the 1940s and he had written a book on numerical analysis [13] (a very successful book that only became obsolete when Argentinean scientists began to use massively computers in the 1960s: Sadosky wrote his book before the introduction of computers in Argentina). Sadosky decided then to carry out three fundamental projects: to obtain a computer for the School, to create an institute of applied

mathematics, as an institutional "base" for using the computer, and to create a computer science degree.

The institute, named "Instituto de Cálculo", began to work in 1960, and was definitively approved by the High Council of the University of Buenos Aires in 1962, as the first institute in agreement with the new regulations of the University. Sadosky was its Director since the beginnings until the 1966 coup, and he was helped by his main collaborator, the mathematician Rebeca Guber. A detailed description of the first years of the Instituto del Cálculo may be consulted in the interview to Sadosky [14]; a semblance of his personality may be seen in [3]. The Institute, although associated with the Department of Mathematics, was a "de facto" Department of Computer Sciences, because all research and development in computer science in Buenos Aires was carried out there; besides the senior researchers, many graduate and undergraduate students worked day and night at the Instituto, with an amazing enthusiasm, in many different projects, all original and challenging.

With regard to the computer, it is interesting to see the process that finished with its acquisition. Firstly, it was necessary to decide whether the computer should be bought (abroad) or should be constructed in our country. In fact, both ideas were implemented, with different results: at the School of Engineering of the University of Buenos Aires, there was a project, directed by Humberto Ciancaglini, to build a computer, named CEFIBA (Electronic Computer of the School of Engineering). The computer was built between 1958 and 1962 and, in spite of the tremendously unfavorable circumstances, (see [2]), the project was useful to train the participants. CEFIBA was above all an ambitious exercise, discontinued after the 1966 coup d'état.

On the other hand, the School of Sciences decided to buy a computer. A committee was formed, whose members were Sadosky, Alberto González Domínguez and Simón Altman (Altman, who had worked at Oxford University, was the only one that had experience with computers), that prepared the international tender. There were bids from four firms, namely IBM, Remington and Philco from USA and Ferranti from UK. Once it was decided that the computer to be bought was the Mercury II from Ferranti (for which a group of scientists of the University of Manchester had created a programming language, Autocode, easy to learn and friendly for scientific applications), a grant was requested to the University of Buenos Aires and to the recently created National Council for Science, to pay for the £152,099 purchase. The fact that Rolando García was the Deputy President of the National Council of Science helped to convince its Board of Directors to approve a grant at the end of 1958. Specifically, as García tells [6], the President of the Council, Bernardo Houssay, was opposed to the purchase (he said that he, Houssay, had won the Nobel Prize in spite of not having tools so expensive) and it was necessary that, according to García's strategy, other member of the Board, Eduardo Braun Menéndez, convinced Houssay not to assist to the meeting of the Board in which the grant was assigned. After that, all was made with incredible precision:

the building where the computer would be installed at the University Campus was under construction, and part of it should be ready when the computer arrived, that is, in January, 1961. Meanwhile, the future analysts and programmers were trained, an engineer, the late Oscar Matiussi, was sent during one year to the University of Manchester in 1960 to acquire experience in maintaining the computer and other engineer, Jonas Paiuk, spent three months in Manchester in Ferranti's laboratories. When the computer began to be installed, Professor Cicely Popplewell (who had worked with Alan Turing, with whom her relationship was never easy, see [8]) came from Manchester to complete the training of the local staff. Soon programmers from several national universities (and also programmers from the Uruguayan University of the Republic, at Montevideo) and from different institutes of research were trained. From then on, and till 1966, the computer was intensely used by the groups of research of the Instituto de Cálculo (in mathematical economy, operations research, statistics, applied mechanics, numerical analysis, programming systems and computational linguistics, groups directed respectively by Oscar Varsavsky, Julián Aráoz, Sigfrido Mazza, Mario Gradowczyk, Pedro Zadunaisky, Wilfred Durán and Eugenia Fisher), by other groups of researchers of the School of Sciences and other universities and scientific institutes and by external users to which fees were charged, thanks to which researches and graduate students could be funded. After the 1966 coup d'état all its staff (around one hundred people) resigned, and the Institute disappeared during more than twenty years.

The concept of "powerful tool" has evolved: Ferranti Mercury II had a memory of 1024 40-bits words, an auxiliary memory initially composed of 16,384 words, data input through punched paper tape, and data output through punched paper tape and teletype; later on, Paiuk constructed a converter from punched cards to punched paper tape, and a facility was connected to graph curves ([2] describes carefully the technical characteristics of this computer and others that were installed in those years). The computer needed also a large room specially prepared and air-conditioned. The comparison with the current standard personal computers seems funny. Moreover, of course a short visit to the web pages of manufacturers - and above all manufacturers of supercomputers - gives us a much more impressive image of the technological advance, without taking into account innumerable options of current computers that the Mercury had not.

The third foundational project on computing in Argentina, also carried on by Sadosky, was the creation of the computer science degree (computador científico), presented to the Directive Council of the School of Sciences in 1962, and approved definitively by the High Council of the University in 1963. The computer science program - the first offered in the country - was shorter than the other traditional ("licenciado") programs (that were five years long); its objective was to educate "scientists assistants": programmers, analysts, etc., that could get integrated into the scientific community. Besides, the computer science degree would be useful in the sense that the large public and private companies - that already had began to install

computer equipment for administrative purposes – could hire personnel not necessarily trained by them, with all the flaws that this procedure has.

The computer science curriculum [4] included, as compulsory courses, one-variable calculus, algebra, linear algebra, several variables calculus, probabilities and statistics, complex analysis, programming, introduction to numerical analysis, topics of numerical analysis (errors, interpolation, numerical linear algebra), advanced numerical analysis (numerical solution of ordinary and partial differential equations and integral equations), programming, data processing, operations research, and advanced computational techniques. The students had also to assemble eight credits in elective courses (eight credits usually meant three elective courses). The elective courses included statistics, physics, mathematical economy, advanced programming and others.

The curriculum shows that computer science was not yet understood as an independent science. The graduates in computer science were thought of as qualified auxiliary personnel of the scientists. Anyway, many graduates eventually had very successful professional careers in banks, industries and public administration, what indicates that the general level of the education at the School of Sciences was good, and the students were well trained. Many students, by the way, were students of mathematics and physics that had decided that they did not want to continue an academic career, and that wanted a degree to get a job as professionals in a new and interesting area; besides, the program was shorter than the "licenciado" program. Anyway, before the military coup the authorities were already thinking and working in the creation of the "licenciado" in computer sciences degree. The coup d'état suspended all discussions, and it was necessary to wait until 1982 to have a "licenciado" degree, as in mathematics and the other sciences.

4. Research at the Instituto de Cálculo

It is interesting to follow the history of some of the former members of the Instituto de Cálculo after their resignations as a consequence of the attack against the universities in 1966, because the histories show both the research done at the Institute and the success and influence that many of its members had later.

Oscar Varsavsky (who, in fact, did not resign after the assault on the universities, but some months before, to go to Caracas to work at the Central University of Venezuela and at the Center for Development Studies, CENDES) continued. On the one hand, his ambitious project of mathematical modeling in social sciences, for which he affirmed that he needed a type of mathematics different from the type of mathematics used as a language for natural sciences, but that used the computer as a basic tool. On these subjects, he had begun to work at the Instituto de Cálculo, see for instance [5], [12], [16]. In 1970 he returned to Argentina after having implemented a series of mathematical models (demographic,

educational and economic) in CENDES, that required an intensive use of computing, and his activity had a more and more political bias until his passing away in 1976. He considered that scientists should be qualified professionals involved in a "liberating" political project and, with his openness, perceptiveness and confronting style - that he maintained during all his life - spent a lot of time popularizing this standpoint writing a series of books, to me very arguable, but plenty of interesting ideas. We can specially mention [17] and [18]. In the 1970s his influence in some intellectual circles in Latin America was considerable.

Mario Gradowczyk headed a group on computational fluvial hydraulics and hydrodynamics and continued his research on fluid mechanics in Montevideo, Boston (MIT) and the Argentinean National Agency for Atomic Energy until 1970, when he began his work as a private consultant in mathematical models in fluvial engineering.

Julián Aráoz settled in Venezuela, where he continued his academic career until his retirement, with an intermission when he was in Canada finishing his Ph. D. studies. Both his Ph. D. thesis and his subsequent academic activity were centered in combinatorial optimization. Aráoz collaborated generously with Argentina from the restoration of democracy in 1983 on, fundamentally as invited professor at the Department of Computer Science of the School of Science of the University of Buenos Aires (that was created in 1985, after the restoration of democracy) and at the ESLAI (Latin American College of Informatics).

It is worth mentioning that, when they worked at the Instituto de Cálculo, Aráoz and Varsavsky directed a project on simulation of Andean rivers [1], after an agreement with the Argentine Federal Council of Investments (CFI) and the Economic Commission for Latin America and the Caribbean (ECLAC). This was probably the first contract in Argentina related to applied mathematics, and was similar to - but developed independently of - the Harvard Water Program, world leader in water resources planning. Had the experience of the Instituto de Cálculo not been shattered, Argentina could have now an internationally known academic school in water resources planning - subject particularly important for Argentina.

Pedro Zadunaisky got a position at the San Miguel Observatory and later at the National Agency of Spatial Activities (CONAE). He returned to the Department of Mathematics of the School of Sciences of the University of Buenos Aires after the 1983 restoration of democracy, and is currently professor emeritus. He continues active, working, as usual, in numerical solution of the equations of celestial mechanics (an asteroid has his name).

Sigfrido Mazza emigrated to Brazil, where he was one of the founders of the Brazilian Society of Statistics. Wilfred Durán emigrated, as many others, to Venezuela. While working at the Instituto de Cálculo, Durán, with his collaborators Cristina Zoltan and Clarisa Cortés, had implemented the programming language COMIC, that was friendlier than Autocode for certain researches at the Instituto de Cálculo.

Besides, many young scientists worked at the Instituto de Cálculo, in the different groups, that later stood out individually. We can include among them Víctor Yohai, founder of the school of robust statistics in Argentina, currently professor emeritus at the School of Science of the University of Buenos Aires; Roberto Frenkel and Arturo O'Connell, distinguished economists (O'Connell is currently member of the board of the Argentinean Central Bank and Frenkel was member of the board of the Bank of the Province of Buenos Aires); Alberto Minujin, specialized in sampling in underdeveloped countries; the late Jorge Sabato, sociologist and former Minister of Education of Argentina during the Alfonsín administration, that had prepared, with Oscar Varsavsky, a mathematical model of an Utopian society [12]; Cecilia Berdichevsky, one of the first programmers of Argentina, currently an active member of the Argentinean Society for Informatics and Operations Research; Alberto Rivas, who after the 1966 military coup went to MIT and obtained there a Ph. D. degree in linguistics; Víctor Pereyra, who specialized in numerical analysis and worked in Venezuela and USA (his interesting remembrances may be consulted in [11]); and Hugo Folguera, that created the group of research in applied mathematics at FATE Neumáticos, first group of research in a private firm in Argentina, group that, after the untimely death of Folguera in 1979, could not survive the economic policies of the Videla's dictatorship.

Finally, Manuel Sadosky, after the restoration of democracy in Argentina in 1983 was during all the President Alfonsín administration (1983-1989) his Secretary for Science and Technology, where he contributed to the revival of computer science (see [9]). He died in 2005. Rebeca Guber collaborated with him as Under-Secretary for Operational Coordination, and is currently member of the Board of the Argentinean Agency for Promotion of Science and Technology.

It is remarkable, as may be seen analyzing these histories, how interdisciplinary was the work at the Instituto de Cálculo: its members afterwards oriented themselves to very different areas of research. In particular, it is worth mentioning that Sadosky always insisted in *applied* research and was an extraordinary manager, with a profound insight in and solid knowledge of the problems which could be solved at the Instituto: the Instituto had many clients, and all of them wanted numerical solutions to original and, in many cases, sophisticated mathematical problems in science and engineering. The income from contracts was several times more significant for the Institute than its ordinary budget.

5. Computer Science Outside Buenos Aires

The previous paragraphs may induce the reader to think that computer science was developing only in Buenos Aires; this is not true, as can be checked describing Jorge Santos project in Bahía Blanca [15]. At the end of 1956, before the brand-new Southern National University was one year old, Santos organized the Seminar on

Computing with senior students of the electrical engineering program, germ of the current Laboratory of Digital Systems of the Department of Electrical Engineering and Computers. When Santos returned from a sojourn in Manchester, UK, between 1959 and 1960 (with a fellowship from the National Council of Science to study logical design of computers) his group began to work in the development of a small computer and to research in multivariate algebras and their electronic implementation. The construction of the computer was suspended when, after President Frondizi was overthrown by the usual military coup d'état in 1962. The grant on which it depended, awarded by the Province of Buenos Aires, was interrupted (in 1976 the former main participants in this group were fired from the University by the military dictatorship, so that the group disappeared until, in 1987, Santos returned to the University and recreated the group, that is currently active).

6. Conclusions

In the mid-1960s the activity in computer science, both professional and academic, was rapidly developing in Argentina, with a growth characterized by the enthusiasm of people involved, both professionals with other backgrounds, young students, brand-new graduates and even practitioners without degrees, when President Illia was overthrown by General Onganía coup d'état, followed by the revocation of the autonomy of the universities. Although it is perfectly known the damage that this attack on the universities caused to Argentinean higher education and science (for instance, at the University of Buenos Aires more than 1,300 faculty, graduate students and teaching assistants resigned), it is not necessarily known by the general public how this policy was a catastrophe for computer sciences, because it completely destroyed the academic development of the new science in a crucial moment of its development in the world. As an example, let us mention again that *all* the members of the Instituto de Cálculo resigned.

That was the time in which computer sciences began to have significance as autonomous science and technology (let us remember that 1968 was the year of the first curriculum of the ACM) and all that period was lost in our country. In particular, it is worth mentioning that at the School of Science of the University of Buenos Aires the computer, whose replacement was already under study before the military coup, simply disappeared and the degree was offered during fifteen years without computational facilities. The students had to use the IBM 360 computer installed at the University Hospital, or the computer installed at the School of Engineering, where a system analysis degree was created at the beginning of the 1970s on the personal initiative of Emilio Jáuregui.

In short, the balance of the 1966 military coup d'état, regarding informatics, is that it caused the almost total paralysis in research matters, and an abrupt fall in the quality of teaching. The seriousness of this fact and the responsibility of the military

and their collaborators increase when we remark that not only informatics is, together with biology, the area of knowledge that developed most in the second half of the twentieth century, but also that, due to its characteristics, its development in Argentina would had permitted the creation of a high-technology software industry like India's, Israel's and Ireland's.

Acknowledgments

The author grateful acknowledges Jorge Santos his valuable commentaries on the Southern National University and Rosita Wachenchauzer her critics and remarks although, of course, he is the only responsible of the opinions here expressed. Besides, he acknowledges Eugenia Kalnay, Jonás Paiuk, Antonio Martese and Rebeca Guber for their lively and interesting remembrances of the Instituto de Cálculo.

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